For editorial reasons, the following commentary to the target article of *Theoretical Linguistics* 2006 (2) by Juliette Blevins, 'A Theoretical Synopsis of Evolutionary Phonology', could be published only in this issue.

Mimetic gemination in Japanese: A challenge for Evolutionary Phonology*

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1. Introduction

Blevins's Evolutionary Phonology attempts to derive most if not all synchronic phonological patterns from diachronic changes: "[R]ecurrent synchronic sound patterns are a direct reflection of their diachronic origins, and, more specifically ... regular phonetically based sound change is the common source of recurrent sound patterns. Evolutionary Phonology ... investigates this hypothesis and explores its consequences for phonological theory" (Blevins 2006: 120). Evolutionary Phonology suggests that, to avoid duplication in linguistic theory, diachronic explanations must take priority over synchronic explanations whenever possible: "[P]rincipled diachronic explanations for sound patterns replace, rather than complement, synchronic explanations, unless independent evidence demonstrates, beyond reasonable doubt, that a separate synchronic account is warranted" (Blevins 2004a: 5).

As a corollary, linguistic theories should not encode phonetic motivations for phonological patterns in a synchronic grammar: "Synchronic constraints incorporating naturalness or markedness are misguided" (Blevins 2004a: 71; see also 251–258). In light of these assertions of Evolutionary Phonology, my commentary addresses two crucial questions: (i) can all synchronic patterns be attributed to phonetically motivated sound changes? and (ii) should phonetic naturalness be encoded in synchronic

* I would like to thank the following people for their comments, suggestions and criticisms: Kaori Akashi, Kathryn Flack, Edward Flemming, John Kingston, Ove Lorentz, Daniel Mash, John McCarthy, Bruce Morén, Joe Pater, Curt Rice, Kyoko Takano and Christian Uffman.

Theoretical Linguistics 32–3 (2006), 411–424
DOI 10.1515/TL.2006.026
0301–4428/06/0032–0411

grammar at all? Evolutionary phonology would answer positively to the first question, and negatively to the second question. I argue for the opposite answers.

This paper focuses on a productive synchronic phonological process in Japanese. I show that Japanese speakers prefer geminate stops to geminate fricatives, even though both types of geminates are equally well attested with comparable lexical frequencies in the Japanese lexicon. I argue that the preference follows from a phonetically natural constraint, and that none of the canonical diachronic mechanisms provides a satisfactory account for the pattern, contrary to the central premise of Evolutionary Phonology.

2. Mimetic gemination in Japanese

2.1. *Mimetic gemination*

Japanese mimetic words offer an example of the necessity of encoding phonetic naturalness in a synchronic grammar. Mimetic words are sound-symbolic, and are very common in Japanese. Mimetic roots frequently appear in reduplicated forms. Some examples of reduplicative C_1VC_2V-C_3VC_4V mimetic words from Nasu (1999) are given in (1). Nasu found that emphatic forms of reduplicative mimetic words are typically created by geminating C_2, when both C_2 and C_3 are voiceless stops. He asked 91 Japanese subjects to choose the appropriate gemination locus for emphatic words in (1). Subjects chose C_2 gemination 83% of the time, and C_3 gemination only 17% of the time.

(1) Emphatic forms created by C_2 gemination

pika-pika	pi**kk**a-pika	? pika**p-p**ika	‘shiny’
teka-teka	te**kk**a-teka	? teka**t-t**eka	‘glistening’

Nasu shows, however, that when C_2 is a voiced obstruent, the possibility of C_3 gemination increases. In words like those in (2) in which C_2 is a voiced obstruent, Nasu’s subjects chose C_3 gemination 51.1% of the time.

(2) The possibility of C_3 gemination increases when C_2 is a voiced obstruent

keba-keba ke**bb**a-keba ~ keba**k-k**eba
'too much make-up'
tsubu-tsubu tsu**bb**u-tsubu ~ tsubu**t-ts**ubu
'granular'

The increased likelihood of C_3 gemination in (2) could presumably result either from a constraint against geminate voiced obstruents, grounded in the aerodynamic challenge that they present (Hayes and Steriade 2004; Jaeger 1978; Kawahara 2006; Ohala 1983), or from the prohibition against geminate voiced obstruents in the native phonology of Japanese. Japanese allows geminates of voiceless obstruents and nasals in the native phonology, and allows geminate voiced obstruents only in loanwords (Itô and Mester 1999; Kawahara 2006).

Put in more general terms, the possibility of changing the gemination locus to C_3 in (2) shows that C_3 gemination can take place when it allows speakers to avoid certain types of geminates. In other words, the likelihood of C_3 gemination reflects the low geminability of C_2. Because of this characteristic, mimetic gemination provides a testing ground for revealing the geminability of different consonant types in synchronic Japanese phonology. The rest of this section reports the experimental result showing that Japanese speakers prefer stop gemination to fricative gemination. In §3, I show that the synchronic knowledge of geminability in Japanese, as revealed in the experiment, does not have any plausible diachronic origins.

2.2. *An overview of the experiment*

Kawahara and Akashi (2006) performed a questionnaire study to investigate the degree of geminability of several consonant types in Japanese. In the experiment, the subjects were presented with two geminated forms of the stimuli, e.g. {*ko**tt**o-koto*, *koto**k-k**oto*}, written in Japanese *katakana* orthography within a frame sentence; the subjects were asked to choose which they preferred. In order to encourage the subjects to respond based on auditory impressions, they were asked to read the two choices silently before answering each question. The following discussion is based on the results from 178 native speakers.

2.3. *Results: Geminability differences between stops and fricatives*

The following discussion focuses on the difference between voiceless stops (= [p, t, k]) and voiceless fricatives (= [s]). The experiment replicated Nasu's results showing that when C_2 and C_3 are both stops, C_2 gemination was predominant (C_2 gemination = 79.2%). In addition, the experiment also showed that the possibility of C_3 gemination increases when C_2 is a fricative and C_3 is a stop (C_2 gemination = 54.7%), and this difference between the two conditions is statistically significant ($t(177) = 9.05$, $p < .001$). In other words, stop gemination is preferred to fricative gemination; speakers avoid geminate fricatives by moving the gemination locus onto C_3, overriding the general preference for C_2 gemination, as schematized in (3).

(3) Differences in geminability between stops and fricatives

pika-pika	pi**kk**a-pika	~	? pika**p-p**ika	'shiny'
pusu-pusu	pu**ss**u-pusu	~	pusu**p-p**usu	'poking'

This result comes as a surprise when one considers three facts about Japanese: (i) both geminate stops and geminate fricatives are allowed, (ii) no phonological processes eliminate geminate fricatives, and (iii) geminate stops and geminate fricatives appear with almost equal frequency in contemporary Japanese. In Amano and Kondo's (2000) database of contemporary Japanese, the averaged log-transformed[1] frequencies of geminate stops and geminate fricatives show almost no differences from one another, both in terms of token and type frequency (TOKEN: stop = 14.12 vs. fricative = 13.85. TYPE: stop = 8.21 vs. fricative = 7.88). Geminate frequencies relativized with respect to corresponding singleton frequencies – i.e. geminate/singleton frequency ratios – hardly differ either (calculated as log-transformed differences; TOKEN: stop = −4.31 vs. fricative = −4.88. TYPE: stop = −3.33 vs. fricative = −3.90).[2] Therefore, statistical

[1] People's knowledge about lexical frequencies is better captured as log-transformed frequencies than raw frequencies (Rubin 1972; Smith and Dixon 1971).

[2] The ratio of [pp]/[p] is excluded, because it is outstandingly high as Japanese singleton [p] historically became [h] in non-mimetic vocabulary (Ueda 1898). This high ratio might be responsible for the higher geminability of [p] compared to that of fricatives; however, such differences in frequency ratios cannot explain why [t] and [k] are more geminable than fricatives.

frequency generalizations across the lexicon do not explain the geminability difference between stops and fricatives. Nor is there any distributional or alternational evidence in Japanese phonology that geminate fricatives are dispreferred. Given that there is no phonological or lexical evidence for low geminability of fricatives, where does the difference between stops and fricatives in mimetic gemination come from?

I argue that the difference in geminability between stops and fricatives reflects the synchronic markedness of geminate fricatives, which is grounded in perceptual phonetics. As Blevins (2004b) points out, geminate/singleton duration ratios are usually smaller for fricatives than for stops because singleton fricatives are inherently longer than singleton stops[3]; the generalization holds across many languages including Egyptian Arabic, Buginese, Chikasaw, Guinaang Bontok, Hindi, Madurese, Swiss German, and Toba Batak.[4] Production data from three female Japanese speakers (Kawahara, unpublished data) show the same tendency in Japanese as well (the average ratios: stop = 2.02 vs. fricative = 1.64). Given that geminate/singleton duration ratios are smaller for fricatives than for stops, singleton-geminate contrasts are perceptually less distinct for fricatives than for stops, as constriction duration differences constitute the primary cue to singleton-geminate distinctions (Aoyama 2000; Esposito and Di Benedetto 1999; Hankamer et al. 1989; Krähenmann 2003). In short, geminate fricatives are synchronically more marked than geminate stops in Japanese, because the singleton-geminate differences are harder to hear for fricatives than for stops.[5]

Because Japanese speakers possess synchronic knowledge that singleton-geminate differences are harder to hear for fricatives than for stops, they avoid creating geminate fricatives in the mimetic gemination contexts. Mimetic gemination is thus optimizing, in the sense that Japanese speakers seek the best consonant for gemination (i.e. a stop) within a word.

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[3] See Kirchner (1998) for an articulatory explanation of the markedness of geminate fricatives.

[4] References: Egyptian Arabic, Japanese, and Hindi are based on my own measurements. Buginese, Madurese, Toba Batak: Cohn et al. (2004); Guinaang Bontok: Aoyama (2004); Chikasaw: Gordon et al. (2000); Swiss German: Krähenmann (2003).

[5] See Boersma (1998), Flemming (1995) and Padgett (2003) for further examples of phonological markedness grounded in perceptual confusability.

Even though the confusability problem between singleton fricatives and geminate fricatives is the cause of markedness of geminate fricatives, the ways in which geminate fricatives can be resolved are diverse cross-linguistically. For example, degemination of geminate fricatives occurs in Klamath (Blevins 2004b). In case of mimetic gemination, Japanese speakers avoid geminate fricatives by shifting the gemination locus. Geminate fricatives are also resolved by way of occlusivization in languages such as several dialects of Berber (Saib 1976: 104–116), Fula (Paradis 1992), and Wolof (Ka 1994). Relevant data from Wolof are shown in (4).

(4) Occlusivization of geminate fricatives in Wolof (Ka 1994: 87–88)

a. The reversive suffix [-i] causes gemination

u**b**	'to close'	u**bb**i	'to open'
te**g**	'to put'	te**gg**i	'to remove'

b. Geminate fricatives are occlusivized

so**f**	'to join'	so**pp**i	'to disjoin'
fa**s**	'to tie'	fe**cc**i	'to untie'
so**x**	'to load (a firearm)'	so**qq**i	'to fire'

The crucial observation is that a structure X can be marked because X is confusable with Y, but it is not necessarily the case that X becomes Y (see Boersma 2005 and Kawahara to appear for similar observations).

Optimality Theory (OT; Prince and Smolensky 2004) successfully accounts for the observation that the direct phonetic cause of the markedness of a particular structure does not uniquely determine how that structure is resolved. Specifically, the confusability of singleton-geminate fricative pairs – and the related dispreference for geminate fricatives – can be expressed as a markedness constraint against geminate fricatives.[6] This constraint, through interaction with other constraints, can trigger a number of phonological repairs to avoid geminate fricatives – a situation known as homogeneity of target/heterogeneity of process (McCarthy

[6] The constraint can alternatively be formulated as a prohibition against a contrast between singleton fricatives and geminate fricatives (Boersma 1998; Flemming 1995; Padgett 2003). My argument does not hinge on how the constraints are formulated.

2002; Pater 1999; Prince and Smolensky 2004), in which the same structure can be resolved by a variety of processes.[7]

Recall now that Evolutionary Phonology's central premise is that all synchronic sound patterns /A/ → [B] derive from a corresponding diachronic change *[A] → [B]. Therefore, the prediction of Evolutionary Phonology is that the three strategies for avoiding geminate fricatives – degemination, occlusivization, and movement of gemination loci – each have a corresponding diachronic origin. In this sense, degemination is correctly predicted by the theory: a high confusability of singleton fricatives and geminate fricatives can result in diachronic degemination, which in turn results in synchronic degemination. In fact, such a historical development happened in Klamath (Blevins 2004b). Geminate occlusivization might be captured as a case of rule inversion: geminate inalterability to a lenition process that targets only singleton consonants (/q/ → [x], [qq] → [qq]) is reinterpreted as a fortition process that targets only geminate consonants (/x/ → [x], /xx/ → [qq]).[8]

However, under the diachronic model of sound patterns, the shifting of the gemination locus in Japanese remains unexplained. In the next section, I argue that Evolutionary Phonology does not offer any plausible account for how the mimetic gemination pattern can arise from diachronic changes.

3. Change, chance, choice

To recapitulate, Japanese speakers avoid geminate fricatives and resort to C_3 gemination when they make emphatic mimetic forms. Given Evolutionary Phonology's goal at explaining sound patterns in terms of diachronic changes, one question arises: can diachronic changes explain the

[7] It should be noted however that standard OT predicts repair strategies that seem unattested cross-linguistically, and therefore to restrict the range of predicted phonological processes is an important task for OT (Lomardi 2001; Myers 2002; Steriade 2001; Wilson 2001).

[8] This is what seems to have happened in dialects of Berber (Saib 1976). This explanation, however, fails to account for the occlusivization of /ss/ to [tt] in other languages, since lenition of /t/ to [s] seems unattested (Kirchner 1998).

mimetic gemination pattern? Insofar as the movement of the gemination locus has its basis in phonetics, the process needs to have a diachronic origin in Evolutionary Phonology. Given that C_2 is the default gemination locus, one would posit the historical development illustrated in (5):

(5) Stage 1: pa**tt**a-pata pa**ss**a-pasa

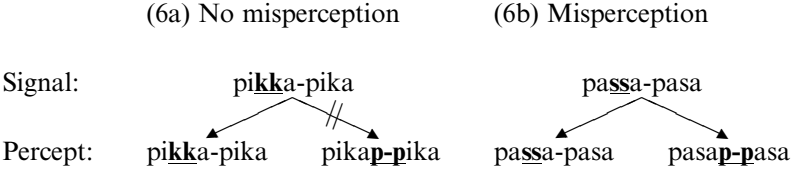
Stage 2: pa**tt**a-pata pa**ss**a-pasa ~ pasa**p-p**asa

There must have been a diachronic change in which geminate fricatives in C_2 optionally changed into geminate stops in C_3, while geminate stops in C_2 remained in C_2. The question then is whether the change from Stage 1 to Stage 2, shown in (5), is possible. Let us address this issue by considering the three mechanisms behind diachronic changes proposed in Evolutionary Phonology: CHANGE, CHANCE, and CHOICE.

3.1. *CHANGE*

CHANGE is a mechanism by which "[t]he phonetic signal is misperceived by the listener due to: acoustic similarities between the utterance and the perceived utterance; and biases of human perceptual system" (Blevins 2006: 126; see Blevins 2004a: 31–44 for more extensive discussion). This mechanism, however, does not explain the movement of gemination locus. It is unlikely that a geminate fricative in C_2 position is ever misheard as a geminate stop in C_3 position, because gemination loci are perceptually unambiguous; in Ohala's (1981, 1993) terms, duration cues are not "stretched out" and hence gemination loci are unlikely to suffer from misperception.

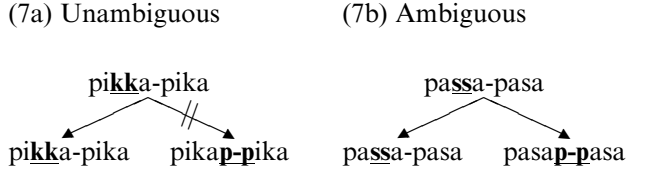
Moreover, even if gemination loci were perceptually ambiguous, we would be forced to assume that misperception has a greater likelihood in cases where C_2 is a fricative and C_3 is a stop – as in (6b) – than in cases where both C_2 and C_3 are both stops as in (6a).



This assumption is untenable: everything else being equal, a geminate fricative should not be more confusable with a geminate stop than a geminate stop is with another geminate stop.

3.2. *Chance*

Chance occurs when "[t]he phonetic signal is accurately perceived by the listener but is intrinsically phonologically ambiguous. The listener associates a phonological form with the utterance which differs from the phonological form in the speaker's grammar" (Blevins 2006: 126).

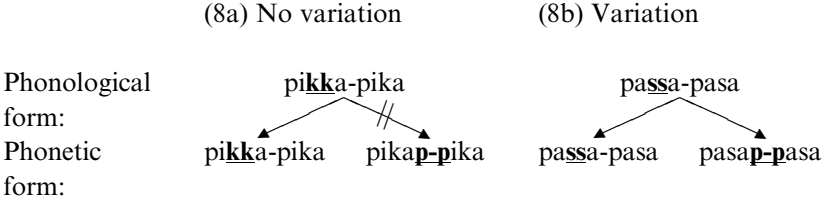


For this mechanism to explain the shifting of gemination loci when C_2 is a fricative, we would be forced to assume that a geminate stop is phonologically not ambiguous, as in (7a), but a geminate fricative is ambiguous between a geminate fricative and a geminate stop, as in (7b). This postulation is unlikely: a geminate fricative should not be ambiguous with a geminate stop, when a geminate stop is not ambiguous with another geminate stop.

3.3. *Choice*

Choice occurs when "[m]ultiple phonetic variants of a single phonological form are accurately perceived by the listener. The listener (a) acquires a proto-type or best exemplar which differs from that of the speaker; and/or (b) associates a phonological form with the set of variants which differs from the phonological form in the speaker's grammar" (Blevins 2006: 126). Choice takes place, according to Blevins (2004a: 82), for cases that involve a synchronic variation along a hypo-hyperarticulation continuum

(Lindblom 1990). However, no evidence has suggested that gemination loci can vary along a hypo-hyperarticulation continuum. Even if such variation existed, we would again be forced to assume that the realization of /pa**ss**a-pasa/ phonetically varies between [pa**ss**a-pasa] and [pasa**p-p**asa] as in (8b), but that the realization of /pi**kk**a-pika/ does not vary between [pi**kk**a-pika] and [pika**p-p**ika] as in (8a).



Again it is implausible that geminate fricatives in C_2 can vary with geminate stops in C_3, and geminate stops in C_2 cannot. To summarize, none of the mechanisms proposed in Evolutionary Phonology explains the mimetic gemination pattern.[9]

4. Conclusions

There exists a synchronic phonological pattern in Japanese which is constrained by a phonetic factor – the geminability difference between stops and fricatives in mimetic gemination follows from a phonetically natural constraint against a contrast with low perceptibility. None of the diachronic mechanisms provides a satisfactory account for the pattern, because the locus of geminate fricatives is not ambiguous acoustically, phonologically, or phonetically. Moreover, even if the locus of geminate fricatives were ambiguous in some way, the explanation would require the implausible assumption that geminate fricatives in C_2 are ambiguous

[9] See also Chapter 7 of Blevins (2004) which explains a number of synchronic properties of geminates (distributional restrictions, inalterability, integrity, etc.) from a diachronic perspective. Due to space limitations, I cannot discuss these analyses of geminates in relation to the mimetic gemination pattern, but none of diachronic properties of geminates can successfully account for the mimetic gemination pattern in Japanese.

with geminate stops in C_3, while geminate stops in C_2 are not ambiguous with geminate stops in C_3.[10]

There are two conceivable ways in which Evolutionary Phonology can sidestep this problem. One is to disregard the pattern as simply a peculiar phenomenon found in the periphery of Japanese phonology; i.e. to regard sound symbolic words as exceptional in being phonologically "random". However, the phonology of Japanese mimetics does not show any random properties at all: they exhibit phonological restrictions found elsewhere in the Japanese grammar, such as a restriction against two voiced obstruents; word formation processes and prosodic patterns in mimetics are also subject to cross-linguistically ubiquitous restrictions (Hamano 1998; Mester and Itô 1989; Nasu 2005). Thus, treating the mimetic phonology as outside the purview of phonological theory is not a reasonable path (see Fillmore et al. 1988 for a more general discussion of related issues).

The second reaction might be to expand the arsenal of Evolutionary Phonology, inventing some mechanism in addition to CHANGE, CHANCE, and CHOICE. However, first, it is not clear what kind of diachronic mechanism can account for the origin of the mimetic gemination pattern (other than encoding active avoidance of geminate fricatives, as proposed above). Second, freely allowing additional mechanisms into the theory seriously weakens the restrictiveness – hence the attractiveness – of the theory.

In conclusion, the mimetic gemination pattern in Japanese is a synchronic, phonetically natural pattern in that it involves active avoidance of marked geminate fricatives, and it has no plausible diachronic origins. This conclusion in no way entails that diachronic changes have absolutely no influence in shaping synchronic phonological patterns. As Blevins argues throughout the paper, many phonetically motivated patterns can be

[10] One might consider geminate fricatives as "articulatory hard" (Kirchner 1998), and say that they are more prone to speech errors than geminate stops – Japanese speakers fail to pronounce a geminate fricative and instead pronounce a geminate somewhere else in the word. This hypothesis is untenable for three reasons. First, it is not clear why mispronunciation of a geminate fricative results in another geminate somewhere else in the word. Second, there is no evidence that this kind of speech error actually takes place. Third, it is unlikely that sporadic speech error patterns can be phonologized to regular phonological patterns.

understood in terms of a diachronic perspective. However, as I have argued, not all phonetically motivated patterns can be reduced to a residue of diachronic changes. Thus, it is important for future research to investigate and determine the proper extent of the respective domains of diachronic and synchronic explanations.

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